Observations of ocean / ice interaction under active
Antarctic ice shelves

NSF OPP sponsored
Tim Stanton and Bill Shaw, Naval Postgraduate School

OBJECTIVES

In order to accurately model ice-shelf / ocean interaction in "warm" ice shelves like Pine Island Glacier, we need to:

- Define circulation processes that bring warm ocean water into the ocean cavity, grounding line

- Understand the role of ocean floor structures (e.g., transverse ridge) in water circulation

- Detail the formation of fresh, buoyant currents as ice melting proceeds

- Understand how melt water currents circulate under the ice shelf and interact with the ice shelf

Pine Island Glacier Ocean Observation System

At each of our three sites, we will deploy:

1) Ocean flux profiler

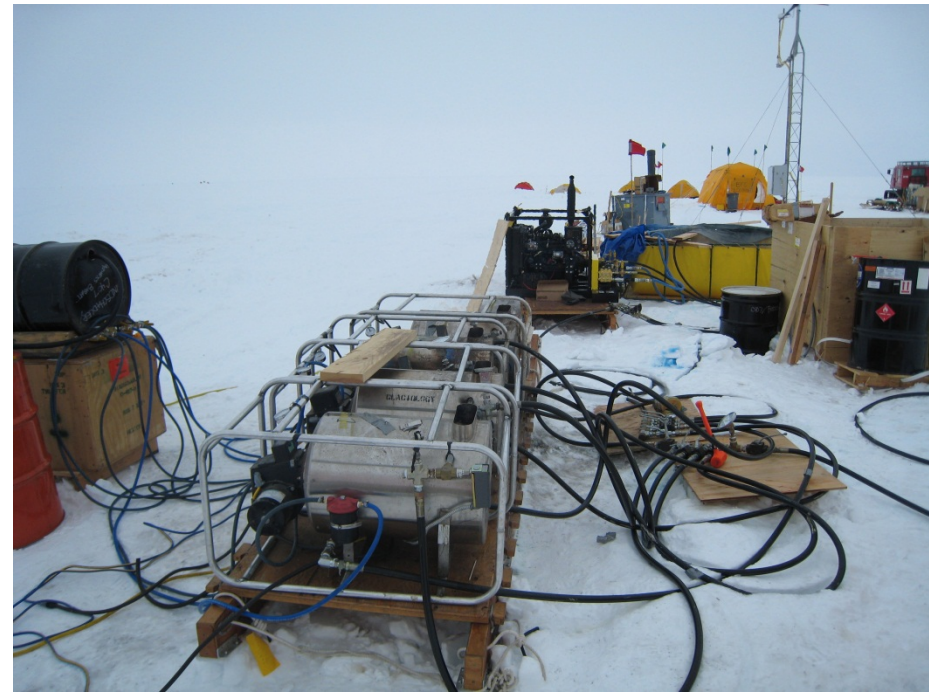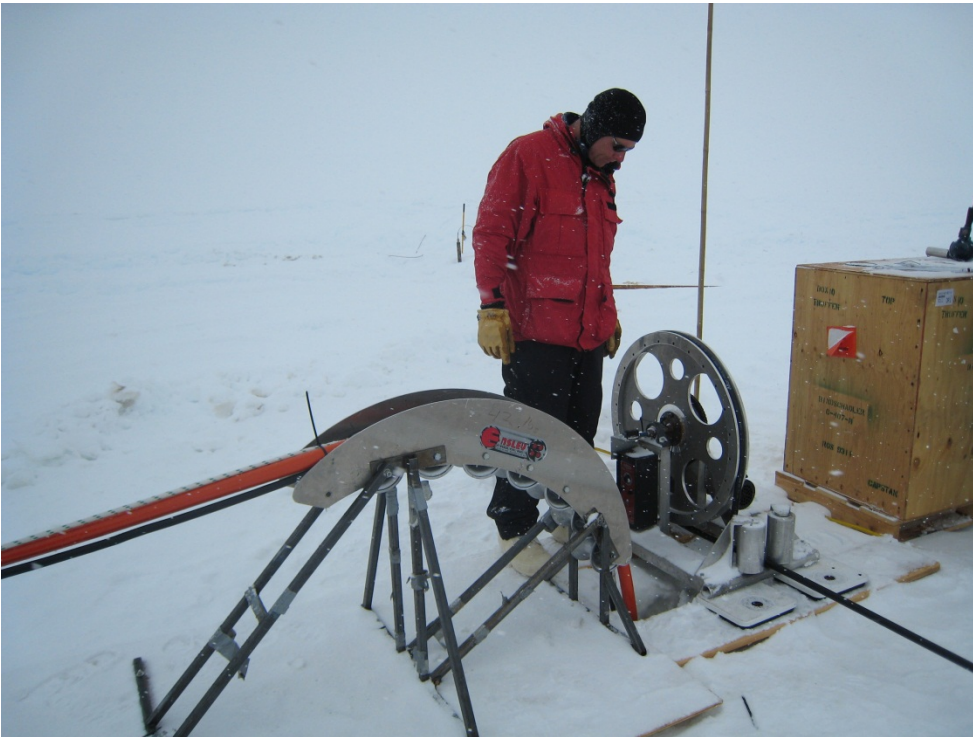2) Fixed-depth ocean flux package
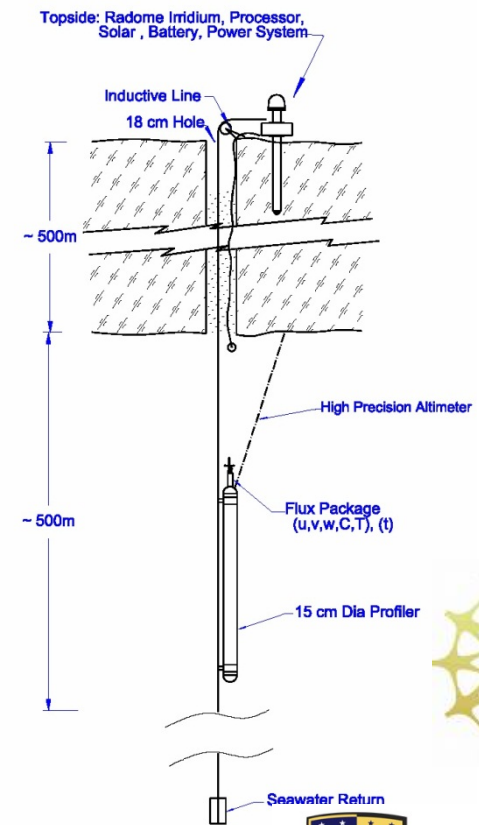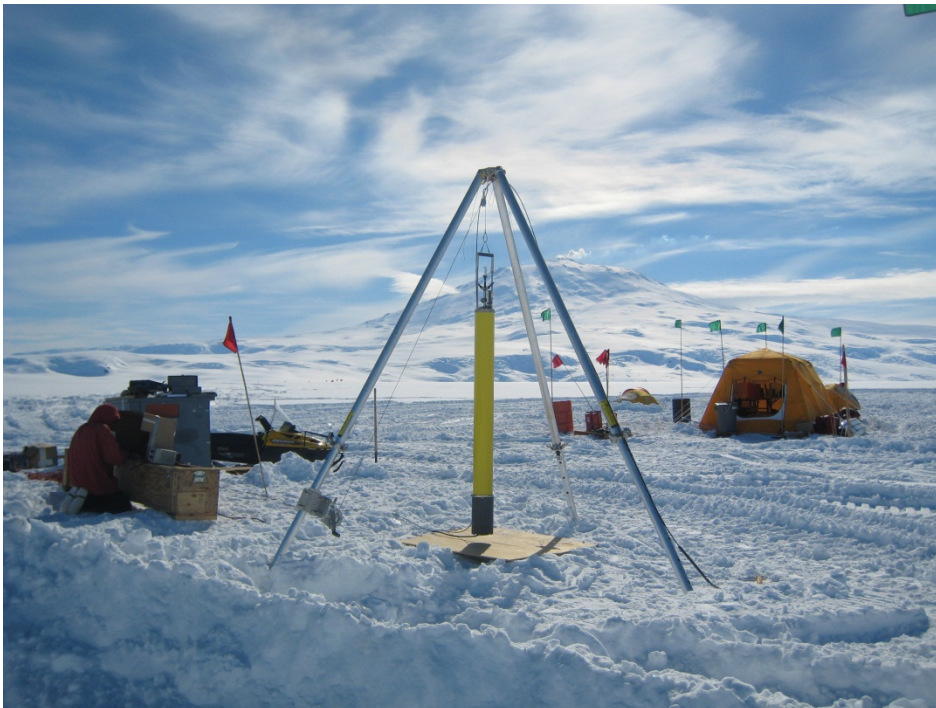
3) Surface infrastructure system

Martin Truffer's hole melting rig

- At each site, we drill two 20cm diameter holes through the 500m thick ice shelf

- Use a diesel-fueled water heater and a water pump system
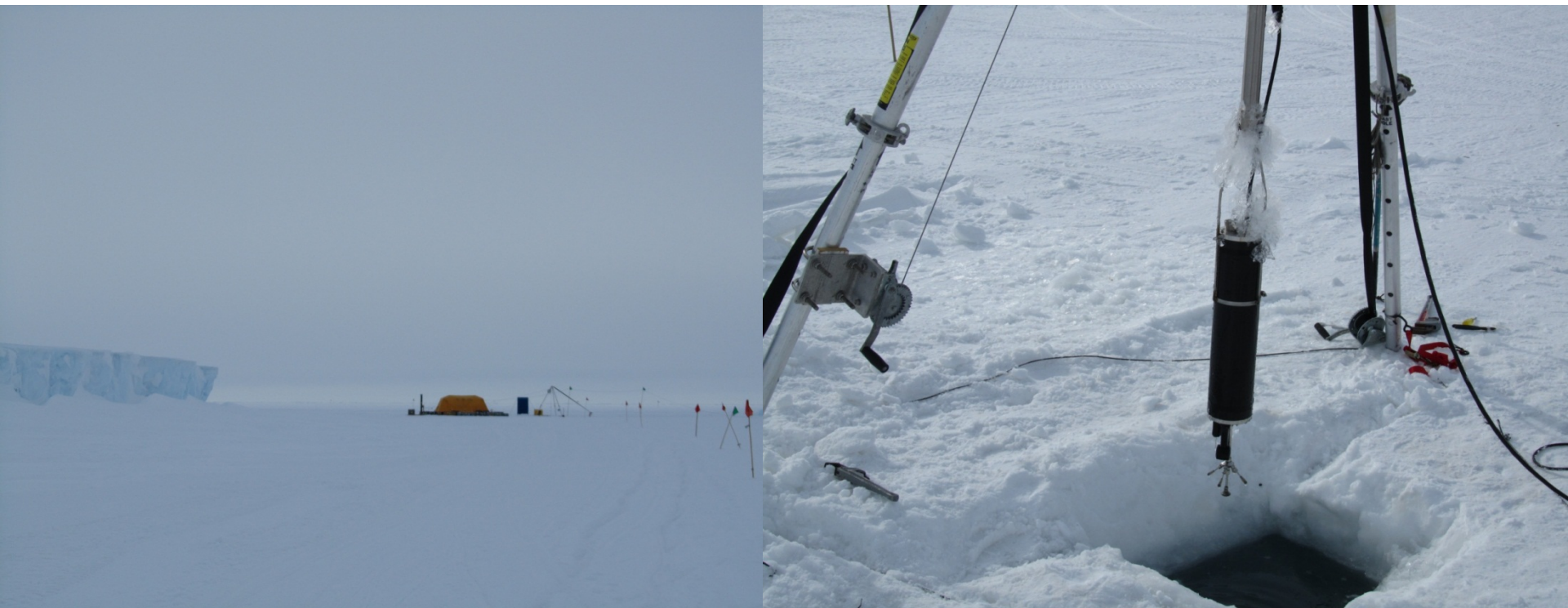
Ocean Flux Profiler:

- Measures profiles of temperature, salinity and vector currents to determine the heat content and circulation within the ocean cavity below the ice-shelf
- Highly adapted to fit tiny, deep hole through the ice shelf
- At remotely selected depths, the profiler can "park" and measure turbulent fluxes of heat, salt and momentum in the water column
- Using precision depth sensors and a profiler mounted altimeter, it will determine the ice melt rates at each site

Topside: Radome Iridium, Processor, Solar , Battery, Power System

Inductive Line

18 cm Hole

~ 500m

High Precision Altimeter

Flux Package
(u,v,w,C,T), (t)

~ 500m

15 cm Dia Profiler

Seawater Return

Fixed-Depth Ocean Flux Package:

- Measures temperature, salinity and 3D vector currents initially 4 meters below the ice shelf / ocean interface to determine the turbulent vertical fluxes of heat, salt and momentum (direct wired to the surface infrastructure system)

- Measures the thermal structure profiles of the ice shelf 100m up from the ocean interface to study the effect of ocean heating events on ice shelf strength

- Directly measures melt rates using a precision altimeter looking up toward the ice shelf's underbelly

Surface infrastructure system:

- Connects to the flux profiler and the deep flux package
- Measures surface meteorology and snow depth changes at each site
- Generates power for the surface systems and deep flux package, using a wind generator, solar panels, storage batteries and a bank of lithium batteries
- Provides two-way communications to our lab at the Naval Postgraduate School: we can receive data back and modify sampling strategies